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Actuator Collision Problem for Multicoordinate Positioning System

Engineering Design

Introduction

The multicoordinate technological systems with parallel kinematics have a number of advantages in comparison with widely used systems with serial architecture, whereas the problem of actuators shared control is to be considered as one of the most important problems. The article describes the elaboration of previously approaches to working out mathematical models, their verification and control system design published earlier.

Collisions avoiding algorithm

The geometrical collision avoiding model is presented on fig. 1. A number of planar linear stepper motors (LSM) denoted on fig. 1 as CP1, CP2, CP3 are moving on the stator across appropriate trajectories determining the areas of their movements.

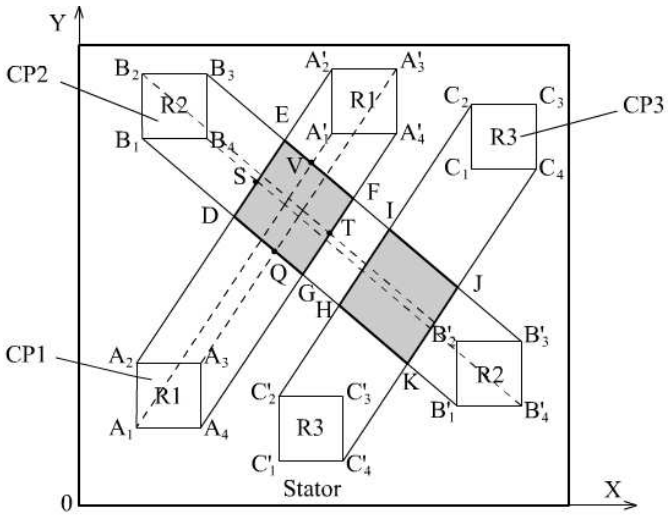

Fig. 1 Geometrical collision avoiding model

It is assumed that rectangular band (fig. 1) determines the area inside which all LSMs are moving. The collision avoiding model is based on geometrical and kinematical analysis of LSM tail areas intersection (for LSM CP1 and CP2 this is a tetragon DEFG).

Geometrical model analysis can give the following situations as the result:

1) there is no collisions during LSM movement, as no tail areas intersection occur;
2) collisions can occur during LSM movement, due to their tail areas intersection. This is the case when collision avoiding procedure will start and build a new movement program;
3) special cases with critical zones which occur in some special configuration, are impossible.

On the basis of geometrical model described, the avoiding calculation algoritm has been implemented for the case of LSM movement with constant speed across appropriate trajectories [1].

When working out algorithm, the following priorities rule was taken into account: the priority of movement belongs to LSM which is the first to enter the intersection zone. This algoritm makes it possible to calculate intersection zone entry times, determine the priorities and motion law for LSM.

Collisions avoiding simulation

The described algorithm was used as the basis for interactive simulation program implementation based on Macromedia Flash Professional 8. The program enables visualization of three LSM which are moving inside the tetragon working area (stator). The problem of collision-free movement is actual for a number of microelectronics technological equipment, for example, for probing equipment, where automatical circuit board testing is possible with four and more probes which are positioned on planar LSM of upper and lower stator [2]. The program helps in solving the problem of collision-free LSM movement and helps motion diagram building for the purposes of control system programming.

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[2] Karpovich S., Mezhinsky Y. Design Aspects of Flexible Manufacturing Systems with Linear Stepping Motors // Proceedings of 41th Internationales wissenschaftliches Kolloquium. Ilmenau, Germany, 1996. - P. 166-170.

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